Nuclear models in FLUKA: present capabilities, open problems and future improvements

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The nuclear reaction models embedded in the FLUKA code can cover hadron, photon and neutrino induced nuclear interactions from energies as low as few tens of MeV up to several tens of TeV.

The application fields which are driving the development of these models are mostly the following:

- Basic research:
  - Neutrino physics
  - Exotic rare events (ie nucleon decays)
  - Cosmic ray physics
  - Simulation of complex experimental apparatus
  - Prediction and mitigation of background for experiments
- Accelerator Driven Systems
- Beam-machine interaction at accelerators
- Radioprotection at accelerators, both "prompt" radiation and induced radioactivity
- Dosimetry
  - Medium and high energy particle conversion coefficients
  - Commercial flight dosimetry
  - Hadron therapy
- Space radiation

FLUKA is currently in use in all these fields by several groups around the world. The present code is an attempt at satisfying the resulting requirements, which are complex and somewhat contradictory.

A (short) description of the main physics ingredients in the FLUKA nuclear models will be given, with emphasis on the intermediate energy range, covering in particular:

- The FLUKA Generalized IntraNuclear Cascade (GINC) and its differences with respect to traditional INC models
- Pion physics in FLUKA at inermediate energies
- The preequilibrium step
- The evaporation/fission/fragmentation step
- How the FLUKA nuclear models have been extended to "exotic" reactions (muon absorption, neutrino reactions, nucleon decays etc) and their importance for future experiments

Examples of performances will be presented for representative situations covering some of the most typical FLUKA applications, and emphasizing the relevance of the various physics steps.

Finally, the open problems and the main lines for the future development of FLUKA will be discussed.

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